Neural Networks

Oliver W. Layton

CS251: Data Analysis and Visualization

Lecture 34

Spring 2019

What is a neuron as a computational unit?

- A neuron in a computational model (e.g. neural network) is often called a (neural) **unit**.

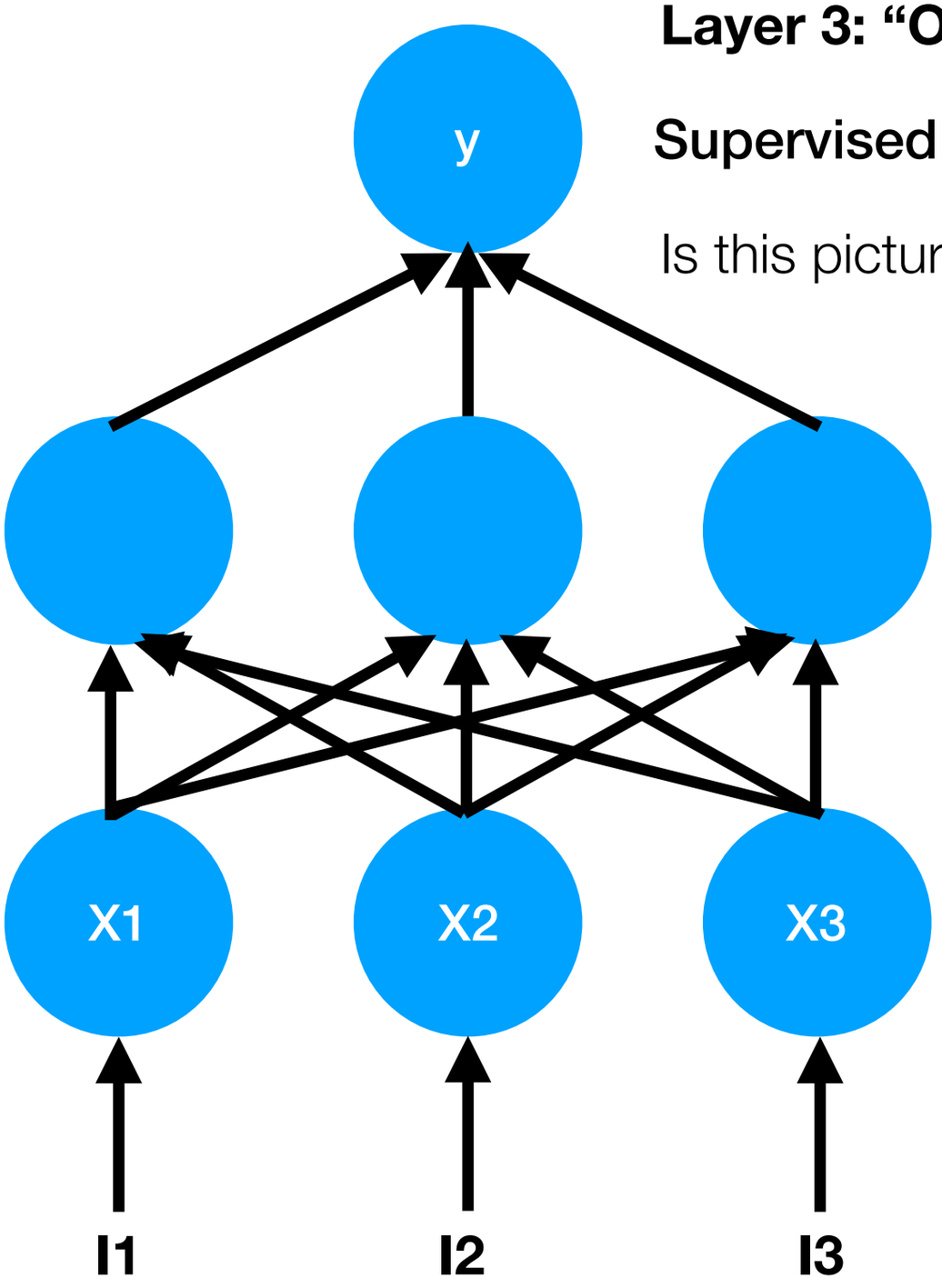
- Neural units are like decision tree nodes, but instead of applying *rules*, they perform *computations*.

- Units may or may not have anything to do with biological **cells** in the brain (also perform computations). We will touch on both kinds.

- Like multi-rule decision trees, neural units can be chained together (e.g. output of one is the input to another). Multiple units together create a **neural network**.

- Let's sketch out what a unit and neural network generally look and and introduce some common terminology.

Feedforward network



Layer 3: “Output layer” “Later”

Supervised learning: y gives us predicted class label.

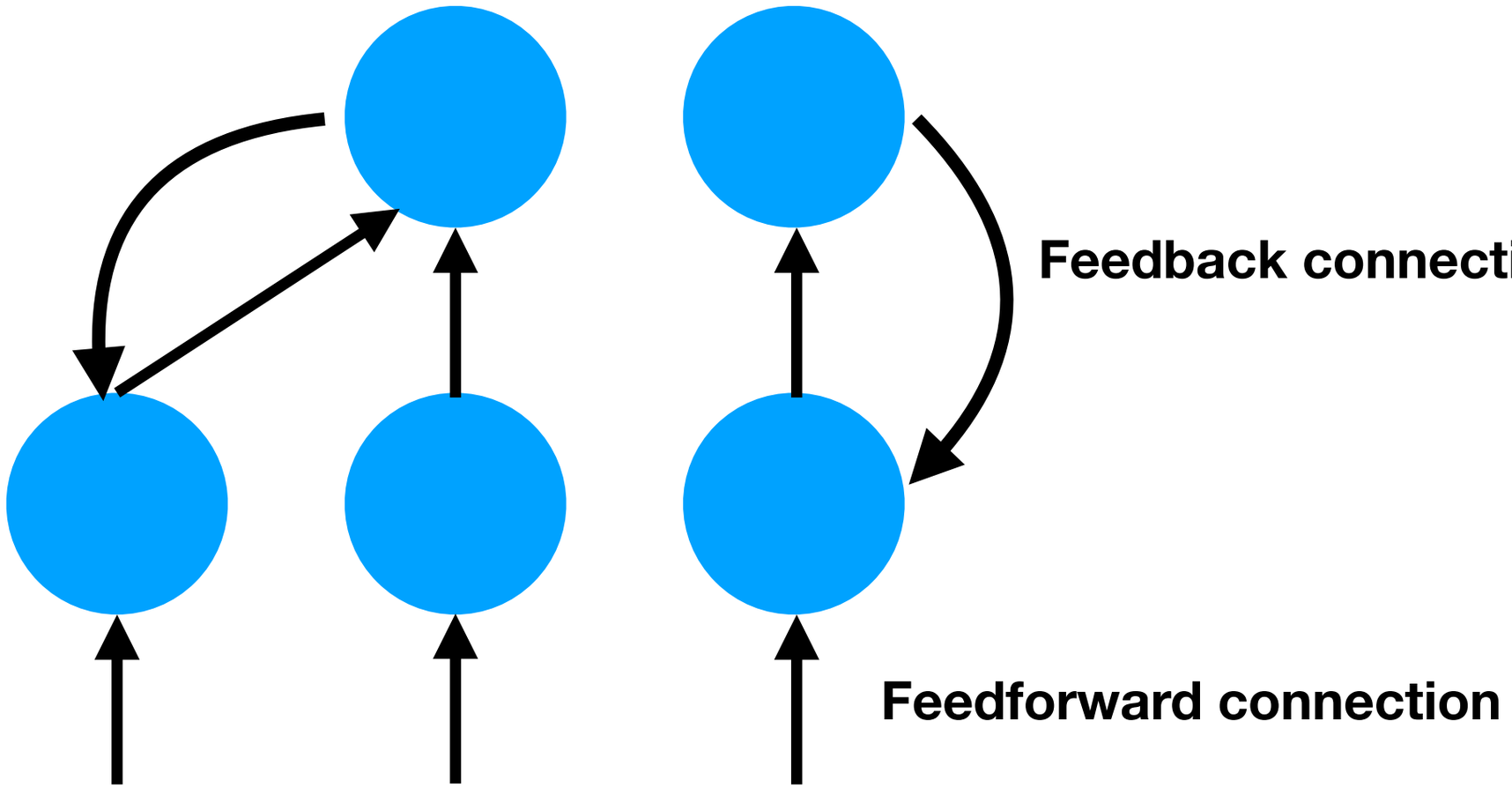
Is this picture of Jennifer Aniston? No (k = 0) or Yes (k = 1).

Layer 2: “Hidden layer”

Layer 1: “Input layer” “Early”

Input

Recurrent network



Feedback: Output of some number of neurons affects activation of neurons in earlier layers

McCulloch & Pitts Neurons (1943)

Mathematicians at the time were obsessed with evaluating **logical propositions.**

`Is Jennifer Aniston in the room?`
`Is Jennifer Aniston not in the room?`

…must evaluate to True or False.

M&P asked: Could neurons implement a logical calculus for answering such questions?

Assumptions

Neural activity is **all-or-none** (spike or not).

Need a minimum number of excitatory synapses
to be active for the neuron (‘unit’) to fire.

Time is **discrete** (t=1, 2, 3…not t=1, 1.1, 1.2, 1.21…). Every neuron takes exactly one time step to compute its output.

Inhibition cancels out excitation.